



Peripheral Artery Disease

Robert Watson, MD
Chief Medical Director
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Talk Objectives

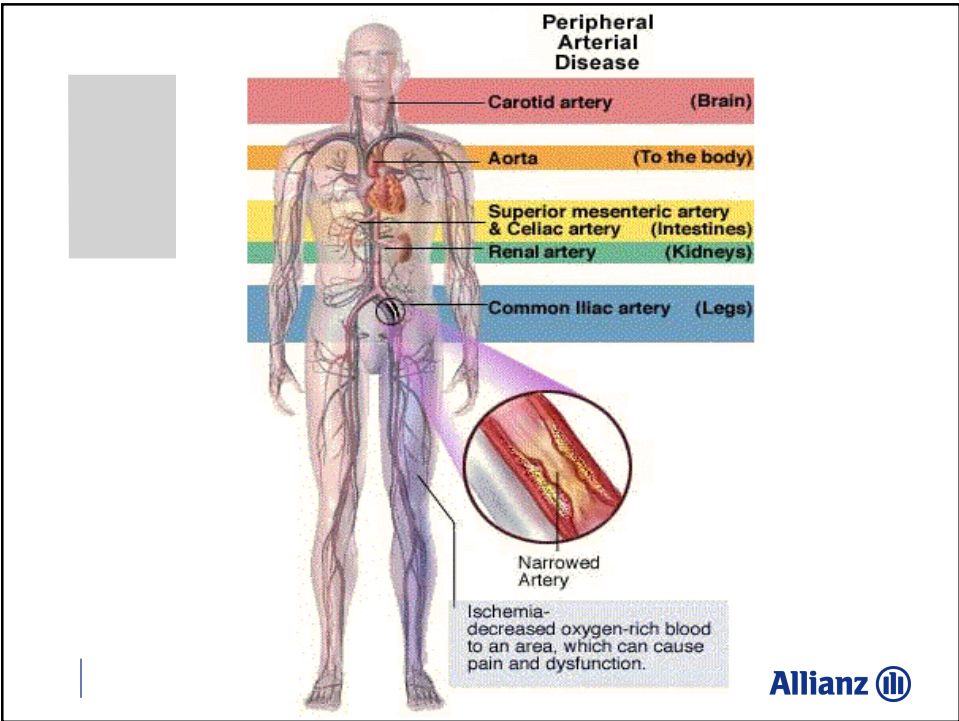
- **To provide an overview of:**
- **the correlation between peripheral artery disease and (other) cardiovascular disease**
- **the role of ankle-brachial artery testing**
- **diagnostic and interventional angiography**

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PAD: definition

“Peripheral artery disease is a condition in which fatty deposits (plaques) build up in the arteries in your legs, arms and other areas, reducing or blocking blood flow. Buildup of plaques in your arteries is a condition called atherosclerosis.”

The Mayo Clinic



Case clinic: 62 yr. old male former smoker

6'0" 230 lbs.; BP 130/57 on Rx; chol 229 on Rx; Strong family history of CAD; father alive age 72 with CAD, but dx'ed "young"

2005: Chest pain on exertion

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Perfusion scan shows apical thinning; onset of bilateral

Developed claudication at 4 minutes on stress test

Ankle brachial index 0.8 on L; 0.9 on R

Arteriogram: 90% popliteal artery stenosis on the left; 80% superficial femoral artery stenosis on the right; both with some collateral flow

Rx: cilostazol, atorvastatin, ramipril

2012: Doing well on meds; can walk a longer distance before claudication onset

| **Rate for the PAD?**

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PAD prevalence

- 12-14% of general population
- 20% of people > age 75
- affects men and women equally
- most PAD is asymptomatic

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Risk factors

The major risk factors

- older age (over 40 years)
- cigarette smoking
- diabetes mellitus
- dyslipidemia (high LDL)
- hypertension

...i.e., the same risk factors as for CAD

Diagnostic approach

- **Symptoms**
- Physical exam
- The ABI
- Arteriography

Symptoms

- **None (78%)**
- **Claudication**
 - intermittent
 - at rest and/or exercise
- **Atypical exertional leg pain**

Claudication

“Pain in one or both legs on walking, primarily affecting the calves, that does not go away with continued walking and is relieved by rest (within 10 minutes)”

Only 45% of subjects with “typical” claudication have PAD.

Claudication: natural history

- 16% will develop worsening claudication
- 7% will undergo lower extremity bypass surgery
- 4% will have major amputations

Diagnostic approach

- Symptoms
- **Physical exam**
- The ABI
- Arteriography

Physical findings

Major

- **diminished or absent peripheral pulses**
- **femoral bruit**
- **prolonged venous filling time**
- **abnormal coolness of the foot**

Other

- color abnormality of the foot (red, pale, or blue)
- absent hair growth
- atrophic skin
- skin ulcer/gangrene

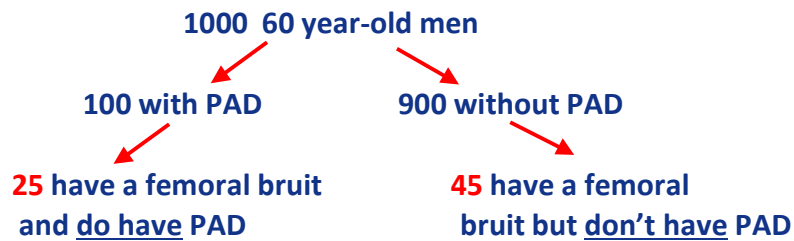
Peripheral pulse pitfalls

- Dorsalis pedis pulse is nonpalpable in 8.1% of normals
- Posterior tibialis pulse is nonpalpable in 2.9% of normals
- Both are nonpalpable in 0.7% of normal extremities
- **About one-third of people with clinically significant PAD have at least one palpable pulse in the affected extremity**

Femoral bruit

20-29% sensitivity for PAD; 95% specificity

For a population with a PAD disease prevalence of 10%:



Diagnostic approach

- Symptoms
- Physical exam
- **The ABI**
- Arteriography

The ankle-brachial index (ABI)

systolic pressure in the posterior tibialis artery
systolic pressure in the brachial artery



Ankle-Brachial Index Interpretation
Above 0.90: Normal
0.71 - 0.90: Mild Obstruction
0.41 - 0.70: Moderate Obstruction
0.00 - 0.40: Severe Obstruction

Right Arm:
Systolic Pressure mmHg

Left Arm:
Systolic Pressure mmHg

Right Ankle:
Systolic Pressure
Posterior Tibial (PT) mmHg
Dorsalis Pedis (DP) mmHg

Left Ankle:
Systolic Pressure
Posterior Tibial (PT) mmHg
Dorsalis Pedis (DP) mmHg

Right ABI equals Ratio of:
Higher of the Right Ankle Pressures (PT or DP) mmHg = *
Higher Arm Pressure (right or left arm) mmHg

Left ABI equals Ratio of:
Higher of the Left Ankle Pressures (PT or DP) mmHg = *
Higher Arm Pressure (right or left arm) mmHg

The lower of these numbers is the patient's overall ABI. Overall ABI (lower ABI)

Ankle-Brachial Index (ABI) worksheet.

ABI as a measure of PAD

- **ABI > 0.9 is “normal”**
- **ABI \leq 0.9**
 - **is evidence of a high probability of significant PAD**
 - **is a predictor of increased CV mortality risk**

ABI as a risk factor

An independent risk factor for both the development of clinical CVD & overall mortality because it usually reflects a collection of lifetime exposures to a variety of risk factors that are likely to have caused diffuse, advanced atherosclerosis throughout the arterial system.

ABI: sensitivity and specificity

A structured review of the sensitivity and specificity of
ABI ≤ 0.90 for detecting a $\geq 50\%$ stenosis.
8 studies comprising 2043 patients.

Findings:

- high specificity (83.3-99.0%)
- low sensitivity, especially in elderly individuals and patients with diabetes (wide range, from 15% to 79%)

Vasc Med. 2010 Oct;15(5):361-9.

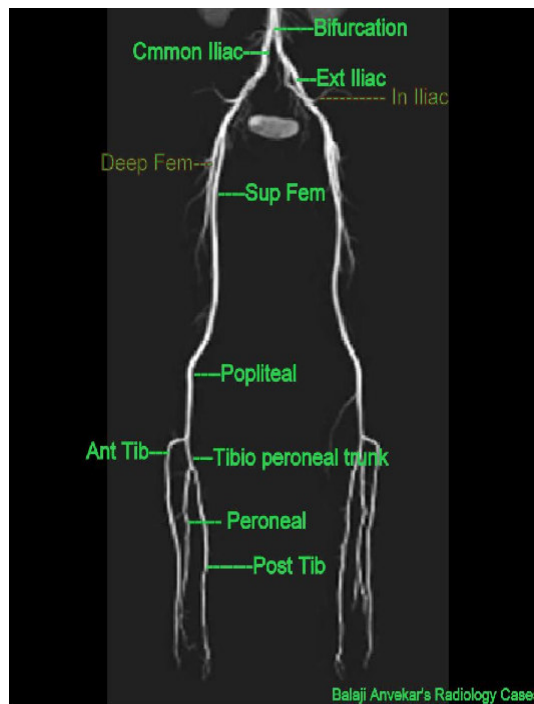
Diagnostic approach

- Symptoms
- Physical exam
- The ABI
- **Angiography**

Angiography

- **Duplex ultrasound**
 - a valuable noninvasive diagnostic test
- **Digital subtraction angiography (DSA)**
 - the “gold standard,” but invasive
 - a diagnostic DSA immediately followed by catheter based procedure in the same procedure is “the preferred approach”
- **CT angiography**
 - Similar to DSA, but quick with 3 D resolution
 - Radiation risk
- **Gadolinium contrast-enhanced MRA (CE-MRA)**
 - up and coming

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This magnetic resonance angiogram (MRA) of the lower extremities was obtained by using the bolus-chase technique. A short-segment high-grade stenosis is present in the middle of the left superficial femoral artery. Note the collateral arterial supply.

Medscape



Medical treatment

Address modifiable risk factors

- smoking
- high blood pressure
- hyperlipidemia
- physical inactivity
- obesity
- diabetes

Meds

- statins (beneficial effects on inflammation, plaque stabilization, endothelial dysfunction, and thrombosis)
- antiplatelet therapy (ASA or clopidogrel)
- ACE inhibitors
- cilostazol (Pletal): improves pain-free walking distance by 50% in people with claudication
- Pentoxifylline (Trental)?



Surgical treatment

Indications for surgical treatment

- to save limbs that might otherwise require amputation
- to relieve ischemic rest pain or tissue loss
- to improve walking distance in patients with life-limiting claudication

Surgery improves mortality risk to the extent that it prevents (or significantly delays) the occurrence of critical limb ischemia.

Surgical treatment (cont.)

Bypass grafting

- Saphenous vein grafting -- reversed or in-situ
- Artificial graft -- Dacron or PTFE (Gore-Tex)
- Human umbilical graft

Percutaneous endovascular angioplasty (PTA) ± stenting

Bypass grafting

13 randomized control trials were included with a total of 2313 patients (1955 above knee, 358 below knee bypass surgery). 5 year patency rates examined.

Conclusions:

- Use saphenous veins if possible
- “Further randomized data is needed to ascertain whether this information translates into improvement in limb survival.”

Cochrane Database Syst. Rev. 2010 May 12;(5):CD001487.

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Associated cardiovascular disease

Because PAD is in most cases a manifestation of a more extensive vascular disease process, there is much “background” mortality due to both that multi-system disease process and the often-advanced age of affected individuals.

The co-prevalence of CAD in patients with PAD depends on how closely it is searched for:

- 20-40% of people by clinical history and/or ECG
- up to 90% of people by cardiac catheterization (“significant” in about 50%)

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Associated cardiovascular disease (cont.)

1070 asymptomatic individuals ages 60-80 with at least two cardiovascular risk factors, selected for ABI measurement

- Carotid stenosis >50% in
 - **14.3%** of subjects with low ABIs
 - **4.7%** of normal ABIs
- Exercise stress test positive in
 - **16.2%** in of subjects with low ABIs
 - **10.5%** of normal ABIs

Spanish study, Vasc Surg. 2009 Jan;49(1):104-8.

Low ABI & mortality risk

Cardiovascular Health Study. 5888 participants with 6 year follow-up.

Subjects age \geq 65 with a low ABI and without clinical CVD at baseline	Relative MR
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Adjusted for CV risk factors **1.62**

Newman AB et al, Arterioscler Thromb Vasc Biol 1999.

Low ABI & mortality risk (cont.)

Meta-analysis of 11 longitudinal studies comprising 44,590 subjects from six different countries

	Overall RR death *	CHD mortality RR *	Stroke mortality *
ABI < .90	1.60	1.45	1.35

*after adjustment for age, sex, conventional cardiovascular risk factors and prevalent cardiovascular disease

Atherosclerosis. 2006 Nov;189(1):61-9.

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Low ABI & mortality risk (cont.)

Meta-analysis was conducted on individuals with no previous history of coronary heart disease. 16 population cohort studies fulfilling the inclusion criteria were included. 480,325 person-years of follow-up of 24,955 men and 23,339 women.

Finding:

- A low ABI ($\leq .90$) was associated with **approximately 2-fold** 10-year total mortality...in each FRS category

Ankle Brachial Index Collaboration, JAMA. 2008 Jul 9;300(2):197-208.



Claudication & mortality risk

3995 subjects. Kaplan-Meier analysis and multivariable Cox proportional hazards regression analysis were used to analyze the association of angina pectoris and claudication with all-cause and cardiovascular mortality adjusted for major cardiovascular risk factors. Median follow-up of 8.5 years.

Findings:

- Compared to subjects without claudication, individuals with claudication had a fully-adjusted **all-cause mortality rate (HR) of 1.79.**

German study, Vasa. 2012 Mar;41(2):105-13.



The continuum of ABI mortality risk

ABI	% mortality in subjects <u>with</u> clinical CVD	% mortality in subjects <u>without</u> clinical CVD
> 1.0	12.9%	4.4%
0.9 to ≤ 1.0	15.4%	8.9%
0.8 to ≤ 0.9	32.4%	14.4%

Cardiovascular Health Study, Arterioscler Thromb Vasc Biol 1999.



High ABI & mortality risk

2159 patients referred with a suspicion of PAD had their ABI and toe brachial index (TBI) measured. **ABI \geq 1.3 was considered falsely elevated** while TBI <0.60 was the diagnostic criterion for PAD.

Finding:

- **greater than 2-fold** total mortality risk among patients with elevated ABI (similar to that noted for the low ABI group)

Finnish study, Vasc Endovasc Surg. 2010 Mar;39(3):316-22.

Underwriting PAD

The “independent” MR runs +60-100 in gen. population. This risk logically scales up or down from the mean for an insurance applicant according to....

- Applicant age
- Extent of investigation for concomitant cardiac disease/carotid stenosis
- ABI result
- Intensity of active CV risk factors
- Compliance with Rx
- Presence and severity of claudication
- Number and severity of obstructions on imaging
- Hx of critical limb ischemia
- Hx and outcome of surgery

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